BACTERIOLOGICAL WATER QUALITY OF

LOWER BEVERLEY LAKE

by

Allan Burger

Bacteriology Branch
Division of Laboratories
ONTARIO WATER RESOURCES COMMISSION

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Abstract

During the July 1970 bacterial water quality survey, the bacterial levels at most stations on Lower Beverley Lake were below the water quality criteria for total body contact recreation. The geometric mean bacterial levels were:

Parameter	Geometric Mean Level
Total Coliform (TC) / 100 ml	59
Fecal Coliform (FC) / 100 ml	2
Fecal Streptococcus (FS) / 100 ml.	3

Higher bacterial levels occurred at stations 1 and 2 on Delta Creek, at stations 18D (depth) and 24 off Farnham Creek and at station 31 near Cooligan Creek. These levels were attributable to the effects of rainfall and the resulting runoff. However, further investigations will be required to determine if the rainfall effects were masking any pollution sources in these areas.

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Introduction

As part of the 1970 Recreational Lakes Program, a single four-day intensive bacteriological survey was conducted on Lower Beverley Lake in Leeds County.

Lower Beverley Lake is located between Highways 15 and 42, north of the Town of Gananoque. The lake has the shape of a Y with the tail of the Y pointing northward. Lower Beverley Lake has inflowing waterways in the north at Cooligan Creek and Mud Lake Creek, in the east at Delta Creek which is a confluence of water from Upper Beverley Lake and Cowan's Creek, and in the west at Farnham Creek. Water flows from Lower Beverley Lake through Lyndhurst Creek into the Gananoque River watershed and through Morton Creek into the Rideau Canal system. Both outflows are in southward direction.

The Village of Delta is located on Delta Creek which flows into Lower Beverley Lake. The remainder of the development on the lake consists of cottage development on the shoreline.

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Methods

During the summer of 1970, one four-day intensive bacteriological survey, July 21 to 24, 1971, was carried out on Lower Beverley Lake. Thirty-four surface stations and three depth (D) stations were sampled daily during the survey period. Bacterial samples at surface stations were taken using sterile autoclavable 250 ml polycarbonate bottles from a depth of about one metre below the water surface. Bacterial samples at depth stations were taken using sterile 237 ml air syringes employing a modified "piggy back" sampler. After taken, the samples were stored on ice and delivered to the Department of National Health and Welfare, Public Health Engineering Laboratory in Kingston, Ontario. All samples were analyzed for total coliform (TC), fecal coliform (FC) and fecal streptococcus (FS) in the laboratory within 24 hours of the sampling. All analyses were carried out by the membrane filtration method as set out in Standard Methods (1) using m-Endo LES agar for total coliform, m-FC medium for fecal coliform and m-Enterococcus agar for fecal streptococcus.

The results from all analyses were organized as replicates representing the station during the survey period. All data was transformed to the natural logarithm (logarithm to

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the base e) and all further statistical evaluation was carried out on the transformed data. Initially, geometric means (the antilogarithm of the average of the logarithm data) were calculated for each station and each parameter. Then an analysis of variance or F-test (2) was carried out in order to group stations which were not significantly different one from the other.

The analysis of variance was first performed on all the stations for a given parameter. If some of the stations proved to be significantly different, the data from these stations was removed to a separate grouping. The analysis of variance was then redone until no stations in the group were significantly different. All groups formed by the extraction of stations from the original group were similarly analyzed. A single set of statistics was then calculated for each homogeneous group of stations.

For convenience, all logarithms presented in the tables in this report are in the form of logarithms to the base 10. Throughout the statistical evaluation of the data, all geometric mean bacterial levels were compared with the water quality criteria for total body contact recreational use as presented by the OWRC (4).

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Results and Discussion

The summary of the analysis of variance grouping of stations is presented in Table I. The station locations and the geographic distribution of bacterial levels are presented in Figure 1.

The geometric mean bacterial levels at most stations on Lower Beverley Lake during the 1970 survey were below the water quality criteria for total body contact recreation at 59 TC/100 ml, 2 FC/100 ml and 3 FS/100 ml. The exceptions to this condition are stations 1 and 2 on Delta Creek downstream of the Village of Delta, stations 18D and 24 in the lake off the mouth of Farnham Creek.

An intermittent rain, early on July 21, the first day of the survey, and a heavy rainfall on July 20, the day before the survey, had a negligible effect on the bacterial levels at most stations. However, this rainfall had a dramatic effect on the bacterial levels at those stations which exceeded the water quality criteria.

Stations 1 and 2 on Delta Creek had high levels on all bacterial parameters (geometric mean levels of 2300 TC/100 ml, 156 FC/100 ml and 133 FS/100 ml). However, all bacterial parameters showed high counts on July 21, the day of the rain,

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with decreasing counts thereafter. A second high count peak occurred on July 23 or 24 in the TC and FS parameters. This direct correlation of high bacterial counts and rainfall, especially for the FS parameter, indicated that the high bacterial levels were largely attributable to runoff and other natural sources. However, this condition could be masking other sources of bacterial input and therefore further investigation is required.

Stations 18D and 24 (the mouth of Farnham Creek) had high bacterial levels and counts. These two stations appear to have been linked in the following manner: On July 21, as a result of the rainfall, high counts were recorded on all bacterial parameters at station 24. At this time the water temperature at station 24 was also much lower (16.3°C) than the rest of the lake (19 to 20°C). This cold high bacterial content water flowed southward across the bottom of the lake reaching station 18D on July 22. High counts were recorded at station 18D on all bacterial parameters on July 22. Thus the high bacterial levels at station 18D (642 TC/100 ml, 21 FC/100 ml and 56 FS/100 ml) and station 24 (16 FC/100 ml and 19 FS/100 ml) were attributable to runoff following the rainfall.

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At station 31, high bacterial levels in all parameters were encountered (3800 TC/100 ml, 485 FC/100 ml and 519 FS/100 ml). Individual counts in all parameters varied greatly with time. High counts recorded on July 21 were followed by decreasing counts until July 23. Then a second peak of high counts occurred on July 24. These high bacterial levels and counts can be attributed to the runoff from Cooligan Creek following the rainfall.

Thus, the bacterial levels at most stations on Lower Beverley Lake were below the water quality criteria for total body contact recreation. The exceptions to this condition were at stations 1, 2, 18D, 24 and 31. At each of these stations the high bacterial levels were attributable to a rainfall on the day before and continuing into the first day of the survey or to runoff following the rainfall. However, further investigations will be required to determine if the rainfall effects were masking any pollution sources in these areas.

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TABLE I

Summary of the Analysis of Variance Grouping of Stations

Lower Beverley Lake, 1970

Survey: July 21 to 24, 1970

Parameters: Total Coliform (TC) / 100 ml

Group:		All stations
F		3.77 df 36, 110
F(5%)		1.65
		SD
Group:	1)	All stations except 1, 2, 5D, 18D and 31
F		1.17 df 31, 96
F(5%)		1.65
		NSD
log GM		1.7731
S.E.		0.0568
N		128.
GM		59.
Group:	2)	Stations 1 and 2
F		1.68 df 1, 6
F(5%)		5.99
		NSD
log GM		3.3610
S.E.		0.3088
N		8.
GM		2300.
Group:	3)	Station 5D
log GM		0.4824
S.E.		0.2512
N		3.
GM		3.

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TABLE I (continued)

Parameter:		Total Coliform (TC) / 100 ml
Group:	4)	Station 18D
log GM		2.8078
S.E.		0.1479
N		4.
GM		642.
Group:	5)	Station 31
log GM		3.5795
S.E.		0.3957
N		4.
GM		3800.

Parameter:		Fecal Coliform (FC) / 100 ml
Group:		All stations
F		4.53 df 36, 110
F(5%)		1.65
		SD
Group:	1)	All stations except 1, 2, 18D, 24, 27D and 31
F		1.41 df 30, 92
F(5%)		1.65
		NSD
log GM		0.3822
S.E.		0.0492
N		123.
GM		2.

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TABLE I (continued)

Parameter: Fecal Coliform (FC) / 100 ml

Group: 2)	**Stations 1 and 2**
F	3.28 df 1, 6
F(5%)	5.99
	NSD
log GM	2.1917
S.E.	0.4265
N	8.
GM	156.
Group: 3)	**Station 18D**
log GM	1.3181
S.E.	0.4916
N	4.
GM	21.
Group: 4)	**Station 24**
log GM	1.2119
S.E.	0.7346
N	4.
GM	16.
Group: 5)	**Station 27D**
log GM	1.3701
S.E.	0.2319
N	4.
GM	23
Group: 6)	**Station 31**
log GM	2.6858
S.E.	0.3978
N	4.
GM	485.

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TABLE I (continued)

Parameter:	Fecal Streptococcus (FS) / 100 ml
Group:	All stations
F	3.78 df 36, 110
F(5%)	1.65
	SD
Group: 1)	All stations except 1, 2, 18, 18D, 24 and 31
F	1.37 df 30, 92
F(5%)	1.65
	NSD
log GM	0.4719
S.E.	0.0508
N	123.
GM	3.
Group: 2)	Stations 1 and 2
F	1.54 df 1, 6
F(5%)	5.99
	NSD
log GM	2.1231
S.E.	0.3594
N	8.
GM	133.
Group: 3)	Station 18
log GM	0.9089
S.E.	0.5815
N	4.
GM	8.

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TABLE I (continued)

Parameter: Fecal Streptococcus (FS) / 100 ml

Group: 4) Station 18D	
log GM	1.7508
S.E.	0.2325
N	4.
GM	56.

Group: 5) Station 24	
log GM	1.2871
S.E.	0.7982
N	4.
GM	19.

Group: 6) Station 31	
log GM	2.7152
S.E.	0.4324
N	4.
GM	519.

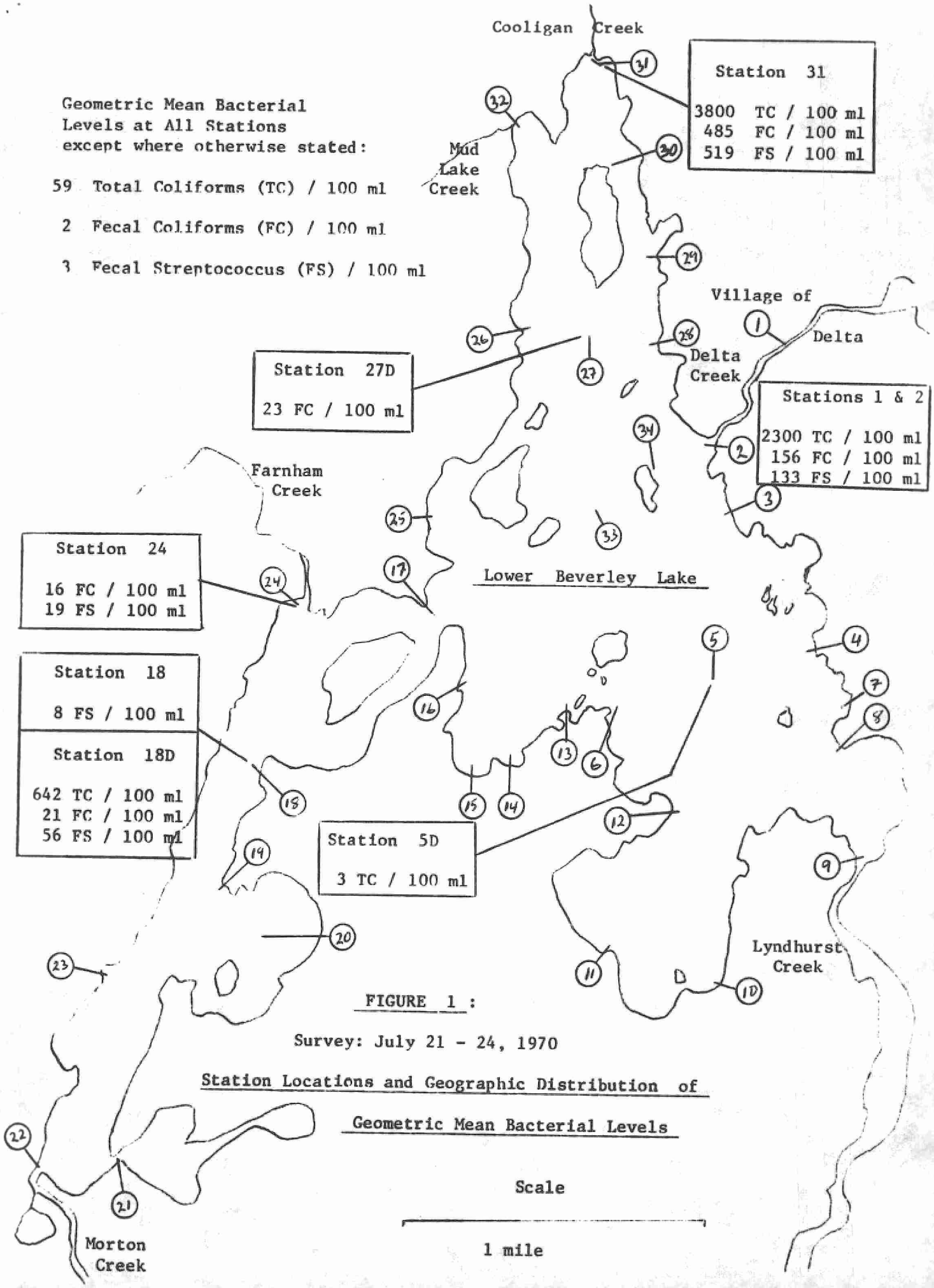

FIGURE 1 :

Survey: July 21 - 24, 1970

Station Locations and Geographic Distribution of Geometric Mean Bacterial Levels